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AUTHOR Garling, Tommy
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ABSTRACT

Multidimensional scaling based on similarity ratings was compared with the semantic differential technique (SDT) in a follow-up study. Previous studies had indicated a fairly close agreement between the results of the SDT and multidimensional scaling which the present study partly corroborated in one experiment for color slides of urban/suburban environmental settings, and in another experiment for color slides of diverse environmental settings (urban/suburban settings, landscapes, buildings, interiors, etc.). The results of principal component analyses and factor labeled in line with previous findings: general evaluation, social status, unity/complexity, and closedness, of which, however, only the first two were common to both the analyses of SDT and similarity ratings. Cluster analyses of similarity ratings suggested that a categorical model rather than the dimensional model more adequately described the structure underlying similarity ratings, type of area, type of setting, and age (or style). In that respect the results were congruent with previous results obtained by means of similarity ratings. (Author/RL)

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A COMPARISON OF MULTIDIMENSIONAL SCALING WITH THE SEMANTIC DIFFERENTIAL TECHNIQUE AS METHODS FOR STRUCTURAL ANALYSIS OF ENVIRONMENTAL PERCEPTION AND COGNITION

Gärling, T. A comparison of multidimensional scaling with the semantic differential technique as methods for structural analysis of environmental perception and cognition. Umeå Psychological Reports No. 155, 1980. - Multidimensional scaling based on similarity ratings was compared with the semantic differential technique (SDT) in a follow-up study. Previous studies had indicated a fairly close agreement between the results of the SDT and multidimensional scaling which the present study partly corroborated in one experiment for colour slides of urban/suburban environmental settings, in another experiment for colour slides of diverse environmental settings (urban/suburban settings, landscapes, buildings, interiors, etc.). The results of principal component analyses and factor analyses gave the following interpretable factors labelled in line with previous findings: General Evaluation, Social Status, Unity/Complexity, and Closedness, of which, however, only the first two were common to both the analyses of SDT and similarity ratings. Cluster analyses of similarity ratings suggested that a categorical model rather than the dimensional model more adequately describes the structure underlying similarity ratings, type of area, type of setting, and age (or style) being the features attended to. In that respect the results were congruent with previous results obtained by means of similarity ratings.

As would seem to be generally recognized in research on environmental perception and cognition, the environment must somehow be represented by the individual, in perception, thinking, and memory (Appleyard, 1970; Downs, 1970; Harrison and Howard, 1972; Lynch, 1960; among others). The important problem is to find out how the individual represents the environment and which features are represented, and to this end semantic differential technique (SDT) type of methods have been tried (Canter, 1969; Küller, 1972; among others).

In previous studies in the present series (Gärling, 1973, 1976a, 1976b), multidimensional scaling methods have been compared with the SDT developed by Küller (1972). Though it is quite possible that multidimensional scaling will give different results than the SDT (cf. the discussion by Gärling, 1973, 1976b), Gärling (1976a) found that for ratings of imagined environmental settings (cf. Lowenthal and Riel, 1972) the correspondence was close enough to suggest that this does not hold within the area under consideration. However, when comparing the results of multidimensional scaling and SDT for ratings of perspective drawings of urban and suburban environmental settings (employed by Gärling, 1976b), the SDT gave only four factors (the General Evaluation, the Social Status, the Unity/Complexity, and the Closedness factors) as compared to eight factors assumed to account for the variance in SDT ratings. Furthermore, as found previously (Gärling, 1973, 1976b) only the General Evaluation and the Social Status factors were common to the multidimensional scaling and the SDT ratings.

In Gärling (1976a) it was suggested that in similarity ratings the subjects attend to the environmental settings, bringing their knowledge to the task, whereas in SDT ratings the subjects may if prompted attend to attributes of space and buildings. It was also pointed out that since only four factors could be isolated in the analysis of the SDT ratings, the results of multidimensional scaling and the SDT may be shown to correspond for those factors not isolated.

In the present study the relation of multidimensional scaling results to the results of SDT were tested further. Firstly, in an attempt to obtain similar results as Küller (1972) for the SDT ratings, colour slides of urban and suburban environmental settings were employed in the first experiment instead of perspective drawings. Secondly, and to the same end, colour slides of diverse environmental settings, partly the same as in Küller (1972), were employed in the second experiment.

Method

SDT and similarity ratings of urban/suburban settings

Stimulus material. Twenty-four colour slides of urban and suburban settings were presented to the subjects in the SDT and similarity rating part of the experiment. The pictures had been taken during the summer in connection with a survey of towns and housing areas over the whole of Sweden. Pictures Nos. 1-7 were of onefamily houses in suburban areas, Nos. 8-16 flat buildings in suburban areas, and Nos. 17-24 flats and office buildings in central urban areas.

Procedure. The SDT was conventionally designed (Osgood et al., 1957), employing 24 seven-step rating scales defined by the bipolar adjectives presented in Table 1. The scales were chosen as to measure all eight factors found by Küller (1972), for the most part three scales with high loadings on respective factor but in some cases other scales added according to the assumed content of the factor (see Table 1). In Gärling (1976a) the selection of SDT scales was shown to be satisfactory by means of a separate analysis of the scales.

In the SDT part of the experiment the subjects were provided a booklet with the SDT scales on each page. The scales were always presented with the negative poles to the left (as in Table 1) and the order randomized in blocks consisting of one scale for each factor. The slides were projected on a wall in a light-proof room (projected size 1.2 x 1.8 m at a viewing distance of 2 to 5 m), the order of presentation being randomized with the first five slides repeated as the last five. The subjects checked the scales during 60 sec presentations of each slide.

Table 1. Semantic differential technique (SDT) scales.

Factors[1]	Bipolar pairs of adjectives defining end-points of SDT scales[2]
Pleasantness	1. Unpleasant - pleasant
(General Evaluation)	2. Repulsive - attractive
	3. Ugly - beautiful
Social Status	4. Cheap - expensive
	5. Inexclusive - exclusive
	6. Low - high social status
Complexity	7. Badly arranged - well arranged
	8. Unrestful - calm
	9. Difficult - uncomplicated
Unity	10. Inconsistent - consistent
	11. Non-uniform - unitary
	12. Incoherent - coherent
Enclosedness	13. Closed - open
(Closedness)	14. Demarcated - not demarcated
	15. High - low enclosedness
Potency	16. Powerless - powerful
	17. Light - heavy
	18. Weak - strong
Originality	19. Common-place - original
	20. Usual - unusual
	21. Probable - improbable
Affection	22. Not picturesque - picturesque
	23. Modern - aged
	24. Artificial - natural

1. According to Küller (1972). The labels within parentheses are preferred here in line with previous labelling (Gärling, 1976a, 1973).
2. The adjectives italized above were used by Küller (1972) for defining unipolar scales.

In the similarity rating part the slides were presented consecutively in all N(N-1)/2 pairs under the same conditions as described above, the order of presentation being randomized with the first 20 pairs repeated as the last 20. The order between slides in each pair was balanced by letting each slide appear as the first one in half the cases, as the second one in the remaining cases. The slides were shown for 10 sec with a pause of 3 sec between slides within pairs and 10 sec between pairs. The subjects were to rate each pair with respect to similarity on an eleven-step numerically and verbally defined scale ranging from 0 (no similarity) to 10 (identity). All slides were shown once for about 10 sec before any ratings were asked for.

Subjects. Twelve undergraduate students of psychology, 5 men and 7 women, took part as subjects in order to fulfill a course requirement. All subjects performed the ratings in a single session, similarity ratings always before SDT ratings. The session lasted for about three hours including two pauses of 15 minutes, one in the middle of the similarity rating session, the other between the different tasks.

SDT and similarity ratings of diverse environmental settings

Stimulus material. The stimulus material consisted of 24 colour slides of diverse environmental settings as urban and suburban housing areas, landscapes, buildings and interiors (see Table 2 which gives verbal descriptions of the settings). The pictures had been taken during the summer in the south part of Sweden, and, those indicated in the table, employed by Küller (1972).

Procedure. The procedure was in all respects identical to that described above.

Subjects. Another 12 undergraduate students of psychology, 7 men and 5 women, took part as subjects in order to fulfill a course requirement.

Table 2. Descriptions of diverse environmental settings.

No	Description[1]
1	Main street in small town
2	Flat buildings (lamellar houses) in suburban housing area
3	Flat buildings (lamellar houses) in suburban housing area
4	(Onefamily) chain-houses in suburban housing area
5	Living-room
6	Farmstead in rural area
7	Holiday houses in recreation area
8	Congested shopping street in central urban area
9	Congested market-place in central urban area
10	Interior view of closed-in shopping centre
11	Interior view of super-market
12	Bank office
13	Snackbar
14	Library
15	Hospital reception hall
16	Hospital hall-way
17	Closed-in railway station hall
18	Industrial plant in rural area
19	Industrial plant in rural area
20	Newspaper editing office
21	Data processing terminal
22	Interior view of manufacturing in industrial plant
23	Church in rural area
24	Landscape

1. Descriptions italized above refer to those pictures presented in Küller (1972), though differently numbered in the present report.

Results and discussion

Urban/suburban environmental settings

The SDT ratings in Table 3 (Appendix) were averaged over subjects as arithmetic means and the product moment correlations between scales subjected to principal component analysis. Four orthogonal factors accounting for the majority of the variance (87 % of the total variance) were rotated on the varimax principle. The results are shown in Tables 4 and 5.

Table 4. Varimax rotated factor loadings for SDT ratings of colour slides of urban/suburban settings.

	Factor No.				
SDT scale No.	I	II	III	IV	h^2
1	.69	.25	.26	-.17	.96
2	.91	.15	.23	-.19	.94
3	.90	.17	.32	-.20	.97
4	.32	.14	.88	.12	.91
5	.44	.23	.84	.11	.96
6	.54	.30	.76	-.07	.95
7	.00	.87	.03	-.31	.86
8	.43	.83	.02	-.14	.90
9	-.43	.50	-.68	-.18	.92
10	.53	.42	.36	-.14	.61
11	.04	.86	.20	.17	.81
12	-.03	.88	-.04	.31	.87
13	.53	.12	.09	-.65	.73
14	.36	-.14	.12	-.80	.80
15	-.59	-.18	-.66	.18	.86
16	.74	-.11	.57	-.16	.91
17	-.09	-.09	.77	-.29	.70
18	.70	.00	.65	-.14	.94
19	.86	.02	.42	-.17	.94
20	.88	.01	.37	-.10	.92
21	.81	-.14	.33	.07	.79
22	.92	.07	.16	-.28	.96
23	.71	.05	-.19	-.58	.87
24	.86	.09	.08	-.38	.91
Variance	9.47	3.79	5.20	2.26	21.00
	40 %	16 %	16 %	9 %	87 %
Eigen values	13.47	3.56	2.86	1.11	

As can be seen by inspecting the factor loadings in Table 4 in relation to Table 1, the interpretations of the factors are not altogether clear-cut. However, factor I is interpreted as the General Evaluation factor since it may reasonably be assumed that the other scales with high loadings, scales defining the Potency, the Originality, and the Affection factors, take on evaluative meanings. Factor II has high loadings for the scales defining the Unity and the Complexity factors and, thus, as in the previous study (Gärling, 1976a), is interpreted as a bipolar Unity/Complexity factor. Factor III is interpreted as the Social Status factor, though other scales have high loadings, possibly because of interference from specific variance due to the environmental settings chosen. Factor IV, finally, is the Closedness factor. The scale high-low enclosedness has no high loading on the factor but according to the comments made by

Table 5. Varimax rotated factor scores for SDT ratings of colour slides of urban/suburban settings.

Environmental setting No.	Factor No.			
	I	II	III	IV
1	0.54	1.24	-1.13	-0.47
2	-0.46	1.23	1.29	1.32
3	0.06	0.66	1.36	0.09
4	-1.05	0.34	1.67	-0.47
5	-0.65	1.51	0.91	-0.44
6	0.06	0.94	0.28	1.32
7	0.65	1.34	-1.24	0.19
8	0.16	-2.28	0.27	0.57
9	1.54	-0.99	0.82	2.77
10	-0.71	-1.23	-0.01	0.06
11	-1.15	-1.18	-1.08	0.60
12	-0.69	0.55	-0.45	0.16
13	-0.24	0.82	-0.56	1.19
14	-0.90	0.03	-1.56	-0.07
15	-0.84	-0.44	-0.96	-0.88
16	-0.99	0.28	-0.84	-0.03
17	1.64	0.74	-1.36	-0.30
18	-1.54	-0.50	0.12	0.42
19	1.44	-0.94	-0.35	0.12
20	1.63	-0.86	-0.34	-0.76
21	-1.02	-0.97	-0.13	-0.64
22	1.20	0.33	0.49	-1.25
23	0.66	-0.70	1.31	-2.08
24	0.46	0.03	1.31	-0.85

the subjects who took part, the concept is obscure when translated to Swedish. By inspecting the pictures in relation to the factor scores presented in Table 5, the factor interpretations can be seen to be supported. The General Evaluation factor mainly differentiates between old and modern urban/suburban settings; the Social Status factor mainly differentiates between onefamily houses and flat buildings type of areas; the Unity/Complexity factor relates to regularity of buildings and spaces; and the Closedness factor, finally, relates to closedness of space as it should.

The similarity ratings averaged over subjects as arithmetic means were subjected to metric multidimensional scaling by means of the procedure described by Torgerson (1958), in which similarities are treated as inversely related to distances and transformed to scalar products for an arbitrary origin. The scalar products are then conventionally subjected to factor analysis. The procedure is preferred here to factor analysis based on the vector model for similarity (Ekman, 1965, 1963) since it reveals bipolar factors and it is not necessary to assume equal vector lengths (Sjöberg, 1975). Table 6 (Appendix) gives mean similarity ratings and similarities converted to scalar products. Mean similarity ratings were also subjected to a form of cluster analysis called typal analysis (Dietze, 1963). In this analysis an exhaustive and mutually exclusive set of clusters of stimuli (types) are revealed by means of objective rules.

The results of factor analysis of mean similarity ratings are plotted in Figure 1 for two orthogonal factors rotated on the varimax principle. The first two factors, accounting for 57 % of the total variance, were the only ones which could be found to correspond reasonably well to the factors obtained for the analysis of SDT ratings; Factor I corresponds to the General Evaluation factor (product moment correlation r with factor scores is 0.52), factor II corresponds to the Social Status factor ($r = 0.65$).

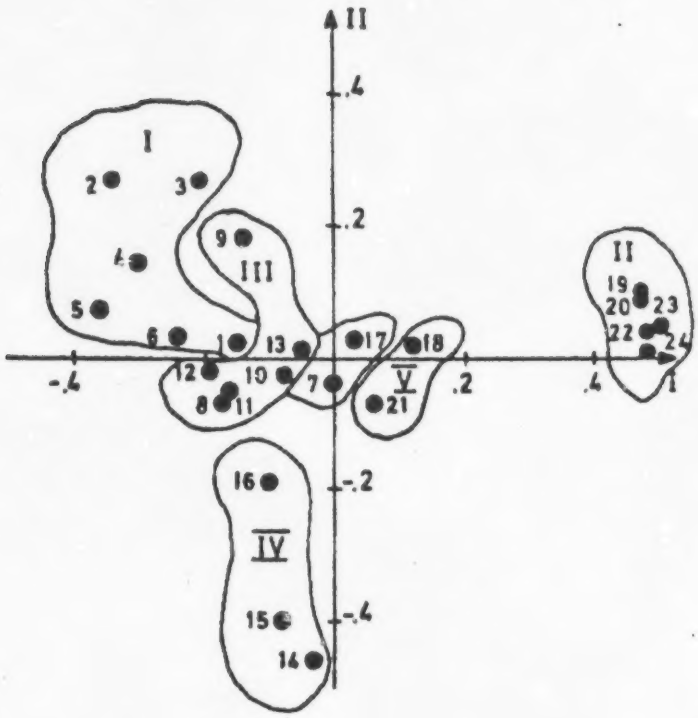

Figure 1. Plots of factor loadings from analysis of similarity ratings of colour slides of urban/suburban environmental settings. The results of typal analysis are indicated by solid lines enclosing stimuli in different clusters (see text for further explanation).

In Figure 1 the outcome of the typal analysis is shown by enclosing the stimuli by lines in each one of the clusters. The types can be given the following interpretations: Type I modern and old onefamily houses in suburban areas, including a town street with two-storey wooden buildings; type II old flats and office buildings in central urban areas; type III modern suburban areas with flat buildings; type IV old suburban areas with flat buildings; and type V modern shopping street and centre in central urban areas.

Diverse encironmental settings

The SDT ratings averaged over subjects as arithmetic means are given in Table 7 (Appendix). The results of principal component analysis of the correlations between scales are shown in Tables 8 and 9 for four orthogonal varimax rotated factors accounting for 91 % of the total variance.

Table 8. Varimax rotated factor loadings for SDT ratings of colour slides of diverse environmental settings.

	Factor No.				
SDT scale No.	I	II	III	IV	h^2
1	.52	-.43	.45	.53	.95
2	.54	-.41	.45	.55	.97
3	.61	-.36	.44	.51	.96
4	.76	-.02	.47	.16	.82
5	.78	-.11	.35	.32	.85
6	.68	-.36	.40	.41	.93
7	.31	-.08	.83	.23	.85
8	.41	-.22	.74	.41	.94
9	-.01	-.45	.80	.04	.85
10	.53	-.05	.72	.32	.91
11	.42	-.06	.81	.30	.92
12	.44	-.17	.78	.35	.95
13	.31	-.83	.37	.20	.96
14	.59	-.74	-.12	-.02	.91
15	-.65	.17	-.45	-.29	.74
16	.81	.04	.21	.43	.89
17	.25	.87	-.20	-.05	.86
18	.82	-.06	.34	.36	.93
19	.65	-.09	.27	.68	.96
20	.61	-.05	.15	.74	.94
21	.12	-.02	.25	.91	.92
22	.58	-.28	.34	.66	.96
23	.45	-.09	.28	.76	.86
24	.71	-.16	.38	.48	.91
Variance	7.61	3.07	5.81	5.20	21.74
	32 %	13 %	24 %	22 %	91 %
Eigen values	16.68	2.34	1.62	1.10	

The results are similar to those of the preceding experiment (see Table 8 in relation to Tables 1 and 4), though the factor interpretations would have been more clear-cut had an oblique rotation been tried instead of the orthogonal one. Factor I is possibly the General Evaluation factor but scales defining other factors have as high or even higher loadings. The closedness factor shows up as factor II, though the scale high-low enclosedness has no high loading whereas the scale light-heavy has. Factor III is clearly the Unity/Complexity factor, having high loadings only for the scales defining the Unity and the Complexity factors. Factor IV, finally, is perhaps spurious since its highest loading is found for the scale probable-improbable which according to the remarks made by the subjects who took part was obscure in meaning. By inspecting the pictures in relation to factor scores given in Table 9, the General Evaluation factor mainly differentiates between natural and urban/suburban settings though age may also be positively correlated; the Closedness factor relates to closedness of space; and the Unity/Complexity factor relates to regularity of buildings and space but it is also conceivable that type of activity is of importance.

The similarity ratings in Table 10 (Appendix) treated as in the preceding experiment gave only one factor found to correspond reasonably well to the factors obtained for the analysis of SDT ratings; Factor I, accounting for 27 % of the total variance, corresponds roughly to the General Evaluation factor (product moment correlation r with factor scores is 0.54). Instead of trying to interpret the remaining factors, the results of typal analysis presented in Table 11 will be commented. By comparing Table 11 to Table 2, it is seen that type I consists of settings in the countryside, type II work settings, type III central urban settings, including a drawing room in a flat situated in a central urban area, type IV interiors of public settings in urban areas, type V flat buildings in suburban areas, including shopping centres, and type VI onefamily houses in suburban areas, holiday houses in the countryside, and town streets.

Table 9. Varimax rotated factor scores for SDT ratings of colour slides of diverse environmental settings.

Environmental setting No.	Factor No. I	II	III	IV
1	-0.47	-0.25	0.64	0.98
2	-0.32	0.30	0.06	-1.35
3	-0.50	-0.78	0.69	0.21
4	-0.06	-0.23	1.29	-0.34
5	0.22	1.19	0.56	0.90
6	1.22	-1.16	0.20	0.86
7	-1.14	-1.49	-0.63	0.07
8	1.17	-1.00	-1.59	0.30
9	-0.20	-1.25	-0.50	2.92
10	-1.05	0.21	-0.10	-0.87
11	-0.86	-0.29	-1.62	-0.63
12	-0.94	-0 53	1.61	-1.39
13	-1.36	-0.58	-0.17	-0.32
14	-1.10	-0.68	0.24	-0.25
15	1.13	1.38	0.28	-0.72
16	-0.98	0.34	0.54	-0.62
17	0.64	0.33	0.80	0.98
18	-0.17	1.54	0.39	0.81
19	0.22	1.49	-0.97	0.64
20	0.17	-0.21	-1.90	-0.58
21	0.66	1.15	-0.75	-0.50
22	0.58	0.90	-1.54	-0.64
23	0.18	1.25	1.27	0.90
24	2.97	-1.71	1.01	-1.38

Table 11. Types revealed by typal analysis of similarity ratings of colour slides of diverse environmental settings.

Type	Environmental setting Nos.
I	6, 23, 24
II	18, 19, 21, 22
III	5, 8, 9
IV	12, 13, 14, 15, 16, 17, 20
V	2, 10, 11
VI	1, 3, 4, 7

Conclusions

Firstly, the results presented here and in Gärling (1973, 1976a, 1976b) are pertinent to the question of the validity of the factors obtained by Küller (1972) by means of the SDT type of procedure, in fair agreement with the results of other studies (cf. Küller, 1973). Actually, only the General Evaluation, the Social Status, and the Closedness factors have received support by the present analyses. The Unity and the Complexity factors merge into one bipolar factor. On the other hand, SDT and similarity ratings of imagined environmental settings also gave evidence for at least the Potency factor, possibly also for the Originality and the Affection factors. The discrepant results are probably not due to the method of representation but the possibility of interference from specific variance due to the environmental settings chosen can not be ruled out. So far, the above conclusions hold for group data since none of the performed analyses have been done for individuals. The results have, furthermore, been treated by conventional factor analytic means with the single exception of Gärling (1973, 1976b).

Secondly, in the first experiment the General Evaluation and the Social Status factors were possibly common to the analyses of SDT and similarity ratings. In that respect the results were congruent with those obtained by Gärling (1973, 1976a, 1976b) for the same type of environemntal settings but represented by means of perspective drawings instead of colour slides. Thus, the dimensional structure and the correspondence between different methods for dimensional analysis may not be dependent on different methods of representing environmental settings. It does, of course, not exclude the possibility that differences in certain respects are obtained, e.g., as found by Gärling (1972) for pleasantness ratings. Furthermore, the typal analysis of similarity ratings gave, as discussed in Gärling (1973, 1976b), evidence for a categorical structure underlying similarity ratings, type of area and age (or style) being attended to.

Thirdly, when presenting to the subjects diverse environmental settings to rate as in the second experiment, only the General Evaluation factor is found to correspond for SDT and similarity ratings. However, this result is not necessarily opposed to those discussed above since in the analysis of SDT ratings the General Evaluation and the Social Status factors were found to merge into one factor. In other words, contrary to expectation, employing diverse environmental settings would seem to make it more difficult to obtain a clear-cut structure on the basis of SDT ratings. Perhaps environmental settings should be chosen from a restricted class but made to vary to a larger extent than has been done previously.

In the second experiment a clear-cut categorical structure is revealed by means of typal analysis of the similarity ratings. Interestingly enough, the clusters or types can be given interpretations compatible with those of the first experiment, i.e., type of area is one factor of importance, but in addition other clusters as work settings, public settings, and settings in the countryside are revealed.

In summary the present results would seem to substantiate the conclusions drawn by Gärling (1973, 1976b): Multidimensional scaling on the basis of similarity ratings reveals a categorical structure, i.e., a system for classification of the environmental settings presented to subjects, which may or may not be invariant over conditions. As has been shown, in some cases the categorical structure may be found to give close correspondence to the General Evaluation and the Social Status factors revealed by the analysis of SDT ratings, due to the fact that the basis for the SDT ratings is partly that obtained by means of similarity ratings. Thus, multidimensional scaling and SDT type of methods may be complementary methods within the area under consideration. The former may be used in preliminary taxonomic work concerning the way subjects

categorize environmental settings, the latter in work concerning the way the subjects react, e.g., affectively to environmental settings (cf. Küller, 1973).

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APPENDIX

Table 3. Mean SDT ratings of colour slides of urban/suburban settings.

SDT scale No.	Colour slide of setting No.																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	5.25	3.83	5.33	4.00	4.42	4.00	5.08	3.17	5.33	2.67	1.58	3.08	4.08	2.17	2.75	2.33	5.67	1.75	6.08	6.25	2.83	6.42	5.42	5.00
2	5.25	3.50	5.08	4.08	4.42	4.17	4.50	3.83	5.58	3.08	2.17	3.67	4.25	3.17	3.33	3.25	5.50	2.25	5.83	6.33	3.08	5.92	5.42	5.42
3	4.67	4.00	4.25	3.42	3.75	3.50	4.33	3.17	5.00	3.00	1.33	2.92	3.42	2.00	2.33	2.58	5.25	2.17	5.25	5.75	2.50	6.08	5.33	5.25
4	3.50	5.58	5.42	5.25	5.42	5.00	3.25	3.75	5.58	3.92	2.83	3.75	3.67	2.00	2.50	2.08	3.50	3.67	4.50	4.08	4.25	5.17	5.17	5.17
5	3.67	5.67	5.42	5.58	5.75	5.00	3.33	3.67	6.08	3.08	1.92	3.25	3.00	1.58	2.08	2.00	3.58	3.08	4.25	4.42	3.00	4.92	5.08	5.67
6	4.83	5.33	5.92	5.25	5.50	4.75	3.75	3.50	5.75	3.17	2.08	3.58	3.58	2.08	2.67	2.83	4.33	3.58	4.50	4.83	3.58	5.75	5.83	5.67
7	5.58	5.33	5.67	5.08	6.00	5.08	5.75	3.00	3.83	4.08	4.17	5.17	4.83	4.83	4.42	5.17	5.50	4.92	4.67	4.50	5.00	5.33	5.00	4.67
8	6.67	5.42	5.25	5.08	5.83	5.42	6.08	3.08	4.42	4.42	3.33	5.00	4.92	4.42	4.33	4.92	5.83	3.67	5.00	5.08	3.58	5.42	4.50	5.58
9	6.17	4.83	4.58	4.58	5.25	4.58	6.08	3.67	3.17	5.08	5.58	5.08	5.58	6.17	5.67	5.83	5.50	4.92	4.25	4.00	5.00	4.33	4.17	4.33
10	4.67	5.67	4.67	5.25	4.67	4.75	4.75	4.67	4.67	3.92	3.75	4.42	5.00	4.25	4.50	4.92	5.50	4.17	4.67	5.25	3.75	5.25	5.17	5.25
11	4.92	5.83	5.17	5.75	5.67	6.00	5.92	4.08	4.83	4.33	4.25	5.25	5.50	4.83	4.92	4.67	5.42	4.42	4.00	4.42	4.00	5.25	4.67	4.92
12	5.67	5.92	5.83	4.83	6.00	5.92	5.75	4.25	5.25	4.33	4.83	5.67	6.08	5.50	4.83	5.50	5.33	5.25	4.92	4.67	4.75	5.17	4.75	5.25
13	5.08	2.92	4.25	3.42	4.58	3.75	4.17	4.17	3.33	3.75	2.83	4.50	3.42	3.00	4.17	3.50	4.92	2.83	4.08	4.42	4.58	5.75	5.25	4.92
14	3.33	2.08	3.33	3.67	3.83	2.92	3.00	3.67	2.33	2.92	2.50	3.00	2.50	3.08	3.75	3.25	3.83	2.50	3.25	4.67	3.33	4.00	5.08	3.25
15	3.83	3.58	2.83	3.25	3.33	3.33	3.67	3.67	2.92	3.67	5.25	4.17	4.42	5.00	4.50	4.50	3.67	5.17	4.33	3.33	4.75	2.42	2.42	2.75
16	3.92	3.92	4.92	4.33	3.92	4.00	4.67	4.67	5.42	3.67	3.08	3.50	3.75	2.42	2.67	3.33	4.25	3.58	5.00	5.17	3.75	5.67	6.08	5.58
17	3.00	4.42	4.67	5.00	3.83	3.25	3.17	3.58	3.58	4.00	3.42	3.17	3.50	3.58	3.58	4.00	3.00	4.00	4.33	3.58	3.50	4.00	4.75	5.17
18	4.08	4.75	4.92	4.42	4.08	4.17	4.08	4.42	5.33	3.25	2.25	3.25	3.83	2.50	3.25	3.08	4.33	3.17	4.33	5.25	3.33	5.25	6.00	5.75
19	3.67	4.42	4.92	4.00	3.58	3.17	4.75	3.92	5.42	2.92	1.75	2.75	2.67	1.75	2.50	1.83	5.33	1.83	5.75	5.50	3.17	6.33	5.83	4.83
20	2.75	3.17	4.42	3.17	2.75	3.08	4.25	3.42	4.83	2.17	1.83	1.58	2.08	1.42	1.92	1.92	5.00	1.33	4.92	4.33	1.92	4.83	4.83	4.75
21	2.92	2.83	3.83	2.92	3.17	3.42	3.17	4.00	4.25	3.08	2.08	2.50	2.75	2.58	2.50	2.58	4.00	2.17	3.83	3.67	2.42	3.25	4.00	3.17
22	4.58	3.08	4.08	2.75	3.08	3.08	5.00	2.67	4.83	2.42	1.25	2.08	2.25	1.92	1.92	1.92	6.08	1.42	6.25	6.33	2.92	6.25	5.58	5.67
23	3.92	1.67	2.08	1.33	1.92	1.92	5.08	1.67	1.67	1.75	1.58	1.83	1.67	3.67	3.08	3.00	5.92	1.75	5.67	6.08	2.00	6.00	5.75	5.83
24	4.17	3.42	3.83	3.17	3.33	3.58	4.25	2.67	4.17	2.83	3.00	2.92	2.92	2.92	3.50	3.17	5.42	2.00	5.17	5.83	2.33	5.83	5.75	4.67

Table 6. Mean similarity ratings of colour slides of urban/suburban settings (above), and similarities converted to scalar products (below and main diagonal).

Colour slide of setting No.	Colour slide of setting No.																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	.19	6.6	5.7	4.3	6.2	4.7	4.9	2.4	3.0	2.9	2.5	3.4	5.6	3.4	4.2	2.7	4.8	1.7	2.3	2.8	1.9	2.8	2.6	1.8
2	.14	.20	6.8	5.9	6.4	6.9	4.2	3.1	4.9	3.8	3.2	4.2	3.2	1.7	2.4	2.8	4.7	2.3	1.3	1.0	2.5	1.4	1.0	1.1
3	.14	.19	.28	5.3	5.4	3.3	3.8	2.5	3.8	2.1	1.3	4.2	1.9	1.3	2.3	1.8	4.2	1.2	1.6	1.6	1.5	2.2	1.5	1.2
4	.04	.12	.13	.21	6.8	8.0	3.7	4.4	5.0	3.2	3.1	4.8	3.8	2.3	2.8	3.4	3.5	2.1	1.3	1.2	1.8	1.2	1.3	0.8
5	.14	.15	.14	.16	.22	6.3	3.6	3.0	3.8	2.7	3.5	4.9	2.3	2.6	3.3	2.3	3.6	2.6	0.8	1.2	2.5	1.3	1.2	0.8
6	.05	.15	.01	.18	.14	.20	4.0	3.9	5.0	3.5	3.2	4.9	3.8	3.1	3.6	1.5	3.8	2.2	1.8	1.2	2.8	1.6	1.7	1.4
7	.06	.03	.04	.00	.00	.01	.19	2.4	3.4	2.5	2.4	4.9	3.8	4.3	4.1	3.4	4.8	1.9	3.4	3.5	1.8	3.4	1.3	3.6
8	-.08	-.02	-.03	.06	-.02	.03	-.08	.23	5.7	5.8	5.1	5.2	5.1	3.2	4.8	4.8	1.8	2.8	0.8	1.5	2.5	1.3	1.6	1.5
9	-.02	.10	.07	.10	.04	.10	.00	.15	.25	2.9	2.6	5.3	3.3	1.5	2.5	2.4	3.4	1.5	1.8	1.6	1.8	1.4	2.2	1.2
10	-.07	.00	-.08	-.04	-.06	-.02	-.10	.12	-.04	.18	7.0	5.6	7.8	3.4	5.4	6.2	1.8	3.2	2.6	2.2	3.2	1.9	2.7	1.8
11	-.08	-.02	-.13	-.02	.01	-.02	-.08	.11	-.04	.16	.22	4.3	4.1	3.7	3.8	4.8	2.3	4.4	1.6	2.1	5.3	1.2	1.9	1.8
12	-.05	.01	.05	.05	.06	.04	.04	.08	.09	.07	.02	.15	5.7	3.8	4.8	5.2	3.0	2.5	1.7	1.5	2.7	2.3	1.4	1.9
13	-.01	-.03	-.09	.01	-.08	.01	.00	.15	.00	.17	.04	.08	.20	2.6	4.3	5.3	2.7	2.5	2.5	2.1	2.8	2.1	2.2	1.6
14	.00	-.12	-.12	-.07	-.04	-.02	.05	.00	-.12	-.01	.03	.00	-.05	.24	7.0	4.9	3.3	3.8	2.4	2.2	4.2	2.1	2.1	2.3
15	.02	-.10	-.07	-.06	-.02	-.02	.01	.06	-.06	.08	.01	.03	.03	.17	.18	6.8	3.1	2.8	2.1	1.9	3.8	2.4	2.4	2.2
16	-.07	-.05	-.09	-.01	-.08	-.16	-.02	.08	-.06	.12	.08	.07	.10	.10	.14	.21	2.7	3.5	1.5	2.3	3.8	1.6	1.7	2.5
17	.06	.07	.08	.00	.02	.02	.07	-.12	.02	-.13	.07	-.06	-.05	.01	-.04	-.05	.22	1.4	3.4	2.5	1.9	4.0	3.4	3.2
18	-.12	-.06	-.11	-.08	-.03	-.08	-.10	-.02	-.11	-.01	.08	-.08	-.05	.06	-.05	.02	-.13	.26	4.5	4.5	6.5	2.3	4.1	3.8
19	-.06	-.13	-.07	-.13	-.18	-.09	.02	-.17	-.08	-.04	-.10	-.12	-.04	-.02	-.08	-.11	.04	.12	.29	7.0	3.6	5.7	6.5	6.1
20	-.03	-.16	-.07	-.14	-.14	-.15	.02	-.11	-.09	-.07	-.06	-.15	-.07	-.04	-.10	-.05	-.03	.12	.24	.28	4.0	7.6	7.6	5.6
21	-.11	-.06	-.10	-.11	-.04	-.04	-.12	-.04	-.09	-.02	.12	-.07	-.04	.08	.02	.04	-.09	.19	.06	.08	.25	2.7	3.3	3.1
22	-.02	-.12	-.02	-.13	-.12	-.11	.02	-.12	-.10	-.09	-.13	-.08	-.07	-.05	-.05	-.10	.08	-.02	.20	.26	.00	.29	2.9	5.8
23	-.04	-.16	-.08	-.13	-.12	-.11	-.14	-.10	-.04	-.04	-.08	-.15	-.06	-.05	-.06	-.10	.04	.10	.22	.25	.03	.26	.28	7.8
24	-.09	-.14	-.09	-.16	-.16	-.12	.04	-.09	-.11	-.09	-.08	-.10	-.10	-.02	-.06	-.02	.04	.09	.22	.20	.04	.21	.27	.31

Table 7. Mean SDT ratings of colour slides of diverse environmental settings.

SDT scale No	Colour slide of setting No.																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	4.75	1.17	4.83	4.75	5.08	6.42	2.83	4.92	6.42	1.33	1.33	2.75	2.50	2.92	3.33	1.83	5.33	2.17	1.92	1.83	1.92	1.08	5.25	7.00
2	4.83	1.33	5.08	5.00	4.50	6.50	2.75	4.92	6.75	1.42	1.50	2.83	2.42	3.08	3.83	2.08	5.67	3.17	2.25	2.17	2.08	1.25	4.92	7.00
3	4.33	1.42	4.08	4.75	3.92	6.00	2.42	4.67	6.17	1.42	1.17	2.33	2.08	2.58	4.00	1.83	5.42	2.83	2.08	2.00	2.00	1.25	5.17	6.92
4	3.58	3.08	3.17	4.92	4.75	5.33	2.75	4.33	4.33	3.08	2.33	4.00	3.00	3.67	4.83	3.42	4.67	3.42	4.08	3.00	5.00	2.75	5.50	6.75
5	3.83	2.50	3.42	4.58	4.50	5.50	3.00	4.50	5.33	2.08	1.83	2.92	2.25	3.25	3.67	3.00	5.33	3.17	3.00	3.17	5.08	2.58	5.08	6.75
6	4.08	2.25	3.83	4.67	4.83	5.75	3.33	5.17	5.42	2.08	1.83	3.50	2.17	3.17	4.00	3.08	5.17	3.17	3.00	3.00	3.50	1.83	4.33	6.75
7	4.83	3.67	5.25	5.08	5.17	5.33	3.83	4.17	4.25	4.17	2.33	5.42	4.17	4.58	4.67	4.33	5.58	4.75	4.67	2.92	4.00	2.75	5.00	5.75
8	6.00	3.08	5.75	5.33	5.92	6.42	3.08	3.58	5.25	2.58	1.75	4.33	2.25	4.08	4.00	3.25	5.42	4.50	2.42	1.58	2.58	1.92	6.08	7.00
9	5.08	4.58	5.00	5.25	3.67	5.33	4.75	3.50	4.67	4.58	3.50	5.67	4.42	4.25	4.17	4.50	5.08	4.58	2.58	2.83	2.42	3.17	5.25	5.75
10	5.42	4.58	5.25	5.58	5.67	5.42	4.00	4.33	5.58	3.92	3.33	5.00	4.08	4.50	5.25	4.58	5.92	5.33	3.83	4.00	4.42	4.50	5.75	6.50
11	5.50	4.25	5.33	5.50	5.17	5.58	3.75	3.83	5.25	3.17	2.67	5.50	3.42	4.25	4.75	4.75	5.83	5.33	4.58	2.42	4.42	3.00	5.50	6.75
12	5.25	4.17	5.17	5.50	4.75	5.42	4.17	4.25	5.42	4.25	2.75	4.92	3.92	4.33	4.75	4.50	5.67	4.67	4.33	3.25	4.08	3.75	5.67	6.25
13	4.75	3.42	4.83	4.42	2.92	5.42	4.75	4.42	5.67	3.08	2.92	4.50	3.83	4.00	3.08	3.33	4.17	3.00	2.83	3.08	2.75	2.58	3.33	6.75
14	3.42	3.42	3.50	2.92	2.58	4.58	4.08	4.75	3.83	2.92	3.00	3.08	2.67	3.00	2.83	2.58	3.33	2.67	2.83	3.50	2.67	3.33	2.33	5.75
15	4.00	4.17	3.17	3.83	3.08	2.83	4.50	4.50	3.67	5.25	4.58	4.50	4.58	4.58	3.75	4.67	3.42	4.08	4.75	4.58	4.25	4.08	3.75	2.58
16	4.42	3.00	4.42	4.33	4.00	5.92	2.42	4.83	5.67	2.92	1.92	2.92	2.42	2.67	4.75	3.17	5.75	4.92	4.83	3.17	4.25	5.17	5.00	6.75
17	4.50	5.33	3.42	3.67	5.25	3.50	3.33	4.50	3.00	4.67	4.50	3.33	3.25	2.92	6.08	4.17	4.50	5.92	5.83	4.50	4.75	5.58	5.42	3.58
18	4.25	3.75	4.50	4.33	4.17	6.00	2.92	4.58	5.08	3.00	2.42	3.33	3.17	3.00	4.75	3.25	5.75	4.92	4.50	3.42	3.92	4.08	5.00	6.92
19	3.92	1.08	3.08	3.58	4.67	5.75	2.17	4.08	5.67	1.50	1.17	2.17	2.00	2.42	3.75	1.33	5.08	3.33	3.58	2.08	3.17	2.58	4.42	4.92
20	3.92	1.50	2.92	3.33	3.83	5.00	2.67	3.92	5.92	1.67	1.50	1.67	1.75	2.50	3.83	2.17	5.00	4.25	4.17	2.42	3.17	2.50	3.50	4.58
21	2.92	2.17	2.75	2.58	2.92	3.17	2.67	2.33	4.25	2.00	1.75	2.00	2.25	2.42	2.42	2.33	3.08	2.92	2.75	2.00	2.58	2.08	3.17	2.25
22	5.00	1.08	3.75	3.75	4.42	6.58	2.00	5.17	6.58	1.17	1.17	1.50	1.75	1.83	2.50	1.42	5.67	3.25	2.83	1.42	1.67	1.25	5.58	6.50
23	5.50	1.42	3.92	2.25	5.58	5.92	2.58	5.08	6.17	1.50	1.50	1.75	1.50	1.67	1.83	2.00	5.92	5.42	3.83	1.50	1.25	2.17	5.75	5.25
24	4.33	3.00	4.25	3.75	4.50	6.00	2.75	4.33	5.25	2.33	2.67	3.50	3.00	3.17	3.67	2.92	5.08	4.83	3.67	3.08	3.25	3.67	5.17	6.58

Table 10. Mean similarity ratings of colour slides of diverse environmental settings (above), and similarities converted to scalar products (below and main diagonal).

Colour slide of setting No.	Colour slide of setting No.																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	.29	2.8	4.8	3.3	2.1	2.3	3.2	3.8	3.3	2.4	1.3	1.8	1.8	0.8	1.9	1.6	3.3	2.6	1.8	1.8	2.3	2.0	2.3	1.6
2	-.01	.23	3.8	2.8	1.6	1.4	3.6	2.2	0.9	4.5	3.3	3.2	2.8	2.0	2.8	3.8	1.3	4.0	4.2	3.3	3.3	3.8	1.9	0.8
3	.14	.06	.27	5.1	2.3	3.7	4.8	3.3	3.4	1.2	1.9	1.5	1.5	2.5	2.1	2.2	1.8	2.3	1.8	1.5	1.4	1.0	2.2	2.3
4	.05	-.02	.15	.27	2.5	3.5	3.8	2.8	2.8	1.5	2.2	2.5	1.8	2.7	2.0	2.1	2.0	2.0	1.0	1.2	1.9	1.3	3.5	2.8
5	-.01	-.08	-.01	.02	.32	3.0	1.9	2.0	3.1	1.3	0.9	2.8	2.8	2.5	2.8	2.0	1.9	1.8	0.9	1.7	1.3	1.3	3.1	2.8
6	.02	-.08	.11	.10	.10	.36	2.8	2.2	4.2	0.6	0.8	0.7	0.6	1.1	1.1	1.0	1.3	2.1	0.8	0.4	0.3	0.7	4.8	7.1
7	.05	.06	.13	.08	.03	.05	.27	2.7	2.6	2.0	2.1	1.6	2.4	2.4	1.6	2.3	2.0	2.4	1.4	2.6	1.5	1.9	2.3	2.2
8	.09	-.05	.05	.02	-.02	.02	.01	.28	5.6	1.5	2.1	2.4	3.7	2.2	1.5	1.3	3.3	1.6	1.4	1.7	1.2	0.7	3.3	2.7
9	.07	-.14	.07	.03	.08	.17	.02	.20	.32	1.8	2.5	1.3	2.1	1.2	2.6	1.0	2.8	1.2	0.8	0.8	0.8	0.2	2.3	3.9
10	-.02	.08	-.13	-.10	-.10	-.14	-.06	-.19	-.06	.24	5.3	3.7	2.6	4.5	3.8	4.3	3.0	3.0	3.2	4.0	4.0	3.5	1.4	0.1
11	-.11	.02	-.06	-.04	-.12	-.12	-.05	-.04	.01	.14	.26	3.4	2.6	3.4	3.7	3.7	3.3	1.9	2.3	4.1	3.8	3.4	0.8	0.8
12	-.07	.01	-.10	-.02	.02	-.13	-.10	-.02	-.10	.04	.04	.25	3.9	3.3	4.7	4.5	2.6	1.3	1.7	5.3	4.3	3.0	1.7	0.9
13	-.06	.00	-.09	-.07	.04	-.12	-.01	.08	-.01	-.01	.00	.08	.28	3.4	3.1	2.9	2.7	1.3	1.4	4.2	2.8	1.5	1.8	1.2
14	-.15	-.07	-.01	.00	.01	-.08	.02	-.03	-.09	.10	.05	.03	.06	.27	5.3	2.9	2.0	1.0	1.3	4.1	4.1	2.8	2.0	0.6
15	-.07	-.04	-.07	-.07	.00	-.11	-.11	-.11	.00	.04	.04	.09	.02	.14	.22	5.3	4.1	1.4	1.5	3.9	3.7	3.4	2.0	1.6
16	-.09	.04	-.05	-.06	-.04	-.11	-.04	-.12	-.13	.07	.07	.09	.01	.00	.12	.24	3.3	2.1	1.9	5.3	4.7	3.3	1.9	0.7
17	.07	-.12	-.05	-.04	-.02	-.05	-.04	.06	.04	.02	.02	.00	.02	-.04	.08	.04	.30	2.8	1.2	1.8	1.9	1.2	1.9	1.1
18	.02	.08	-.02	-.04	-.03	.02	.00	-.06	-.08	.02	-.05	-.11	-.09	-.12	-.11	-.05	.03	.30	6.6	2.3	2.3	4.3	2.7	0.8
19	-.04	.11	-.04	-.11	-.09	-.09	.05	-.06	.11	.05	.00	-.06	-.06	-.08	-.09	-.05	-.08	.26	.33	2.4	3.5	5.8	2.5	0.8
20	-.08	.01	-.10	-.13	-.06	-.16	-.01	-.08	-.14	.07	.08	.14	.10	.09	.05	.13	-.06	-.03	.00	.25	4.8	2.6	1.7	0.8
21	-.03	.01	-.11	-.06	-.09	-.17	-.10	-.12	-.14	.07	.06	.08	.01	.09	.04	.10	-.05	-.02	.08	.12	.26	5.3	2.3	0.7
22	-.03	.07	-.12	-.10	-.07	-.10	-.04	-.14	-.17	.06	.06	.03	.07	.02	.04	.04	-.09	.13	.22	.00	.16	.30	1.2	0.7
23	-.01	-.07	-.03	.07	.07	.19	-.02	-.06	.01	-.10	-.15	-.08	-.06	-.04	-.06	-.07	-.04	.03	.03	-.05	-.08	-.10	.29	4.5
24	-.01	-.12	.03	.07	.09	.33	.03	.07	.17	-.17	-.10	-.09	-.05	-.11	-.04	-.12	-.05	-.08	-.07	-.11	-.11	-.09	.19	.40